UNIVERSITI TEKNOLOGI MARA

ACRULeT
ASIAN CENTRE FOR RESEARCH ON UNIVERSITY LEARNING AND TEACHING

Asian Journal of University Education

Faculty of Education

Vol.13 No.2 December 2017 ISSN 1823-7797

ASIAN JOURNAL OF UNIVERSITY EDUCATION
A Publication of
the Asian Centre for Research on University Learning and Teaching (ACRULeT)
Faculty of Education, Universiti Teknologi MARA

 ISSN 1823-7797

Asian Journal of University Education is a journal by Faculty of Education, Universiti Teknologi MARA Selangor, Aras 5 & 7, Bangunan FSK 1,5, Kampus Puncak Alam 42300 Bandar Puncak Alam Selangor Darul Ehsan. E-mail : edu_info@salam.uitm.edu.my

ACRULeT
ASIAN CENTRE FOR RESEARCH ON UNIVERSITY LEARNING AND TEACHING

Asian Journal of University Education

Faculty of Education

Vol. 13 No. 2 **DECEMBER 2017** **ISSN 1823-7797**

‘PROTEIN SYNTHESIS GAME’: UTILIZING GAME-BASED APPROACH FOR IMPROVING COMMUNICATIVE SKILLS IN A-LEVELS BIOLOGY CLASS

Mohd Adlan Ramly[1]
mohdadlan@salam.uitm.edu.my

Nurul Aida Binti Kamal Ikhsan[2]
nurulaida@salam.uitm.edu.my

Nur Rahimatul Hayati Binti Abdul Rahman[3]
rahimatul@salam.uitm.edu.my

Norlizayati Binti Ramlan[4]
norliz2901@puncakalam.uitm.edu.my
[1]Faculty of Education, Universiti Technologi MARA
Kampus Puncak Alam,
42300 Bandar Puncak Alam,
Selangor, MALAYSIA

[234]Centre of Foundation Studies Universiti Technologi MARA
43800 Dengkil, Selangor, MALAYSIA

Received: 25 July 2017
Accepted: 28 October 2017

ABSTRACT

This experimental paper seeks to elucidate the usage of the card game ‘Protein Synthesis Game’ as a student’s learning tool in studying the Biology topic of protein synthesis during an A-Level course. A total of 24 experimental students in 3 induced groups and 24 controlled students in controlled groups were involved in the experiment which began with a pre-test on the topic of Protein Synthesis, followed by the experimentation, and ended with a post-test administered after the incubation period. Results indicate that students have better facilitative communicative engagement in learning protein synthesis when playing the game as compared to

studying the topic from a book. The data suggests that such communicative engagement may lead to a successful meaningful learning on the students' part.

***Keywords**: Communicative Skills in Biology; Protein Synthesis; Learning with Play; Protein Synthesis Game*

INTRODUCTION

Maija Rintola stood before her chattering class of twenty-three 7- and 8-year-olds one late April day in Kirkkojarven Koulu. A tangle of multicolored threads topped her copper hair like a painted wig. The 20-year teacher was trying out her look for Vappu, the day teachers and children come to school in riotous costumes to celebrate May Day. The morning sun poured through the slate and lemon linen shades onto containers of Easter grass growing on the wooden sills. Rintola smiled and held up her open hand at a slant—her time-tested "silent giraffe," which signaled the kids to be quiet. Little hats, coats, shoes stowed in their cubbies, the children wiggled next to their desks in their stocking feet, waiting for a turn to tell their tale from the playground. They had just returned from their regular 15 minutes of playtime outdoors between lessons. "Play is important at this age," Rintola would later say. "We value play." (Hancock, 2011)

The recent development of the Finnish government announcing that their school system would very soon abandon the idea of learning according to subjects shocked the world. While many orthodox experts deem the move too volatile and formless, others welcome the move that glorifies knowledge over statistical results on paper. Today, all over the world, educators have begun to realize that books, papers and rote learning are no longer relevant to the vibrant, dynamic and rich nature of society. In the recent European Committee of the Regions (CoR) Katrin Budde (DE/PES), Member of the Landtag of Saxony-Anhalt stressed that mass production of graduates as workers in mechanical manner is no longer relevant as knowledge-based economy is now the future of sustainable and stable economic climate (Ouvinen, 2017). In the case of Rintola above, the educator had moved from content-biased teaching style to learning with play, emphasizing more on the experience of learning and the authenticity and meaningfulness of it. The

most important realization is that how can such subjective and fluid method of teaching fit into more concrete fields like science and mathematics? As an effort to heed this call, the researchers invented a card game called Protein Synthesis Game to help students in understanding the concept of protein synthesis in Biology. Findings in using the game with foundation level students show that there is a significant difference in the quality of communication skills.

The main objective of this paper is to present the findings of an experiment done on foundation level science students in learning about protein synthesis, a topic in Biology. The specific objectives of the study are:

1. To presenting the Protein Synthesis Game and its mechanics.
2. To presenting the research method used to experiment on the usage of the Protein Synthesis Game in a real learning environment of protein synthesis and how it affects the communicative process of such learning experience.
3. To discuss findings of the aforementioned experiment and the significant meaning to the communicative process of learning protein synthesis.

REVIEW OF LITERATURE

Protein Synthesis and the Learning Process

Protein synthesis in its most general sense is the study of biological cell's process of building their specific proteins, the most basic component of cellular functions (Raven, 2005). While the process of protein synthesis is basic, it is a crucial process in cells to sustain their existence as the rapid production of protein compensates the loss of cellular proteins that happens through the process of degradation or export (Spirin & Swartz, 2014).

In its most basic process, protein synthesis can be divided into two stages of "transcription" in which the generation of the mRNA is initiated by synthesizing the RNA from DNA template, while the second stage is the "translation" process in which a specific polypeptide is produced in the process of decoding the mRNA (Moldave, 2012). The process of translation

can be further categorized as the four phases of "activation, initiation. elongation and termination" that describes the selective process of amino acid chain growth as a product of the translation process" (Nierhaus & Wilson, 2009).

Protein synthesis is known to be an important subject matter in the study of biology and all its sub-divisions of study like biochemistry and bio-clinical studies. One of its most important features is the promotion of bio-longevity and sustainability in all biological life forms, in which the respiration of the cells and the generation of energy is based on ATP regulated by proteins (Volpe, 2016). In sports, the understanding of protein synthesis helps with issues concerning athletes' physical performance and injuries:

> In the case of athletes and sportsmen, muscular contractions would be impossible without proteins. Proteins change shape to cause the muscle contractions, allowing movement to take place. The cells would all fall apart if there weren't any proteins holding them to each other (Greenwood, Cooke, Ziegenfuss, Kalman, & Antonio, 2015).

In clinical studies, protein synthesis is useful in the discovery of new antibiotics and drugs for regulating protein in the body like Clarithromycin. It was developed by studying the nature of ribosome in protein synthesis (Rudin, Beckmann & Rausch, 2006)

The Importance of Learning with Play in Studying Science

The need for change in educational pedagogy and methodology in teaching science has been a long-standing issue that both academics and scientific experts have often debated about. While the nature of science is empirical and disciplinary, many educators feel that learners need to master disciplinary knowledge. Forcing the mechanical and serious methods of learning and teaching of science may impede the learning interest and learning process of students, thus creativity and innovation in science education is deemed as highly important (Adzliana, Jizah, Punia, & Kamisah, 2012). An important rationale to why creativity is important in science education is that learners, especially children are imaginative in nature:

> Maybe you're already wondering why I'm suggesting you need to set aside creative time for your children or students. Most children are quite imaginative, and develop creative thinking skills just by encountering new things every day. The importance of creativity in education, particularly in the form of arts exposure, is also fairly well accepted (Garret, 2017).

And although we may be able to become more focused and serious as we become adults, adding the element of creativity and fun in the learning of science often allows us to "acquire" the knowledge in an authentic manner, which is more effective and long-lasting than the traditional rote memorization and drilling method of learning (Adzliana, Jizah, Punia & Kamisah, 2012). An interview with Rober DeHann by Jennifer Cutrarro explains the importance of creativity in science education:

> Talking with others and teamwork also help with associative thinking — allowing thoughts to wander and freely associating one thing with another — that DeHaan says contributes to creativity. Working on a team, he says, introduces a concept called distributed reasoning. Sometimes called brainstorming, this type of reasoning is spread out and conducted by a group of people. (Cutrraro, 2012)

One of the curves in creativity in science education includes the importance of inducing the learning with play concept. While the meaning of being creative in science education may include the usage of ICT elements, project-based education approach or student-based reflective process, the process is often either very complicated to complete or is not plausible in most schools due to infrastructural constraints (Longshaw, 2009).

In a pilot study by Childhaven and University of California, Berkeley, the lead researcher, stresses that science education is often taken as something very stressful and learning with play eliminates such negativity and facilitate several important elements that would foster meaningful education: "The ingredients of play are precisely the ones that fuel learning: in addition to promoting a state of low anxiety, play provides opportunities for novel experiences, active engagement, and learning from peers and adults." (Harvard University, 2017)

In an effort to heed the call for creativity in science education, particularly in utilizing the element of learning with play, the researchers have developed a game to facilitate the learning of protein synthesis called the Protein Synthesis Game.

Protein Synthesis Game

Protein synthesis game is an educational tool played by a maximum of 2-4 players. Students are required to match the DNA sequence following the transcription and translation processes. The winner of the game is the fastest player who manages to build a correct amino acid sequence.

METHOD

In order to see whether the Protein Synthesis Game is effective in enhancing the learning and teaching process of protein synthesis and facilitating communicative skills in the process, a small-scale study was done to test the game. In the study, 48 students for the Foundation Level (post-SPM) were used as test subjects. These students were enrolled in Foundation in Science at the Centre of Foundation Studies, UiTM, Dengkil and were in their second (final) semester of the programme.

The 48 students were selected from three different classes (intact groups) and in each class, they were divided into two groups; one was introduced to the Protein Synthesis Game as a mean to learn protein synthesis, while the other group, the control group, was asked to study the subject matter using articles and books. The induced/controlled group in each class consisted of only 8 students. The selection of the students was based on Stratified Random Sampling method in which, the ratio of male and female and the academic performance of the students were given consideration. Each group consisted high scoring, middle scoring and low scoring students, and a ratio of 6:4 female to male students, reflecting the bigger population of the class as well as the entirety of the students in the Foundation in Science programme.

The research began with the pre-test given to all test subjects, both in the induced and controlled categories. The Pre-Test consisted of 3 structured

questions that covered five learning objectives identified to be significant to the subject matter. The Pre-Test was administered during the same period and location to ensure no impending variables emerge from the physical administration of the test.

Upon completing the Pre-Test, the students were taken into the experimentation stage. Each of the induced group was given a session of 40 minutes to play with Protein Synthesis Game. Once a round was completed, the players would change place. During the administration of the session, the students' activities were recorded with a video camera. Similarly, the controlled groups were also given forty minutes but instead of playing the Protein Synthesis Game, they would read the protein synthesis chapters of their textbooks. Both groups were not given any other directions like asking them to give their opinions. These sessions were done once a week in an incubation period of two weeks.

Once the incubation period was over, the test subjects were given a Post-Test to see whether there would be any significant difference in their performance. At the end of the study, all test subjects were given a questionnaire to reflect upon the process of learning protein synthesis based on their own different experiences. In terms of communication, four constructs were asked and observed which included:

1. Students' ability to be engaged in active listening.
2. Students' comfort to speak and express their opinion freely.
3. Students' use of non-verbal communication.
4. Students' ability to react to other students' opinion with ideas and thoughts.

RESULTS AND DISCUSSION

In terms of communicative skills, the students in both induced and controlled groups exhibited different reactions and levels of efficacy. When referring to the questionnaire, there is not much difference in terms of the students' self-efficacy in evaluating their own competence in communicative skills in the process of learning protein synthesis. The induced group registered an overall mean of 4.052 (at 81% percentile significance) on a Likert Scale of

1-5 with 1 being the lowest and 5 being the highest. Similarly, the controlled group registered an overall mean of 3.98 (at 70% percentile significance), a slightly lower reading.

The difference however is minimal and insignificant. The questionnaire seemed to point out that most of the students, both within the controlled and induced groups, have very high efficacy in seeing themselves as having high level of communicative abilities in the process of learning protein synthesis. Table 1 below illustrates the analysis of the questionnaire based on each item (variables) while Table 2 presents the analysis of the questionnaire based on overall readings.

Table 1: Data Analysis of Questionnaire (Communicative Based Elements Section) for Each Item (Variable)

	Total	Max	Min	Med	Average	%
Induced Group						
Active Listening	104	5	3	4	4.333	87%
Speaking and Expressing Opinion Freely	99	5	2	4	4.125	83%
Non-Verbal Communication Engagement	92	5	2	4	3.833	77%
Reacting to Others' Opinion with Worthy Ideas & Thoughts	94	5	3	4	3.917	78%
Controlled Group						
Active Listening	102	5	3	4	4.25	85%
Speaking and Expressing Opinion Freely	97	5	3	4	4.042	81%
Non-Verbal Communication Engagement	92	5	2	4	3.833	77%
Reacting to Others' Opinion with Worthy Ideas & Thoughts	92	5	2	4	3.833	77%

Note: Percentile is based on total scores deviation. Total Scores is accumulated values on a scale of 1-5 for each item based on the test subjects' responses.

Table 2: Overall Data Analysis of Questionnaire (Communicative Based Elements Section)

	Total	Average	%
Induced Group Overall Communicative Marks	389	4.052	81%
Controlled Group Overall Communicative Marks	383	3.99	80%

Note: Percentile is based on total scores deviation of all items. Total Scores is accumulated values on a scale of 1-5 for all items across all four variables based on the test subjects' responses.

While the students' self-efficacy is high across both groups of controlled and induced groups, the observation done based on the sessions and reviewing of the sessions using the recorded videos showed clear and obvious differences in communicative skills. Based on the observations, the induced group registered an overall mean of 4.167 (at 83% percentile significance) in a Likert Scale of 1-5 with 1 being the lowest and 5 being the highest. On the other hand, the controlled group registered an overall mean of only 2.0 (at 40% percentile significance), a significantly lower reading. An even more important observation is that for the four communicative skills constructs, construct 1 (Active Listening), construct 2 (Speaking and Expressing Opinion Freely) and construct 4 (Reacting to Others' Opinion with Worthy Ideas & Thoughts), the induced groups registered some overwhelmingly high readings. All three constructs registered the mean score of 4.67 (at 93% percentile significance); 4.67 (at 93% percentile significance); and 4.33 (at 87% percentile significance) respectively, indicating that if the third variable (Non-Verbal Communication Engagement) was excluded, the total reading of the Communicative Skills in learning Protein Synthesis by the Induced Groups would have been a lot higher. The observation therefore concludes that based on observable behavioral attributes, the induced groups is more superior in terms of communicative skills in learning protein synthesis as compared to the controlled group. Table 3 below illustrates the analysis of the observations based on each item (variables) while Table 4 presets the analysis of the observations based on overall readings.

Table 3: Data Analysis of Observations (Communicative Based Elements Section) for Each Item (Variable)

	Total	Max	Min	Med	Average	%
Induced Group						
Active Listening	112	5	4	5	4.67	93%
Speaking and Expressing Opinion Freely	112	5	4	5	4.67	93%
Non-Verbal Communication Engagement	74	5	1	3	3.0	60%
Reacting to Others' Opinion with Worthy Ideas & Thoughts	104	5	3	5	4.33	87%
Controlled Group						
Active Listening	48	4	1	1	2.0	40%
Speaking and Expressing Opinion Freely	56	4	1	2	2.333	47%
Non-Verbal Communication Engagement	48	3	1	2	2.0	40%
Reacting to Others' Opinion with Worthy Ideas & Thoughts	40	3	1	1	1.0	33%

Note: Percentile is based on total scores deviation. Total Scores is accumulated values on a scale of 1-5 for each item based on the test subjects' responses.

Table 4: Overall Data Analysis of Observations (Communicative Based Elements Section)

	Total	Average	%
Induced Group Overall Communicative Marks	400	4.167	83%
Controlled Group Overall Communicative Marks	192	2.0	40%

Note: Percentile is based on total scores deviation of all items. Total Scores is accumulated values on a scale of 1-5 for all items across all four variables based on the test subjects' responses.

CONCLUSION

Based on the findings, it can be concluded the Protein Synthesis Game was able to improve students' communicative skills in the discovery process during the lessons. They were observed to initiate dynamic and colorful discussions with one another, engaged in troubleshooting and problem solving discussions to why they had lost the game (if they had lost the game). They also exhibit a strong tendency to voice out opinions and ideas related to Protein Synthesis. This reflects students' self-efficacy where they are able to communicate their ideas and evaluate their worthiness. The Protein Synthesis Game provides a platform for the communication to take place, and simultaneously learn the content of the Biology lesson in a fun and meaningful way. The study indicated that instructors could infuse games as learning tools, and in environment where there is no access to digital technology, a simply card game could stimulate their learning experiences.

REFERENCES

Adzliana Mohd Daud, Jizah Omar, Punia Turiman, & Kamisah Osman. (2012). Creativity in Science Education. *Procedia - Social and Behavioral Sciences, 59*, 467-474.

Cutrraro, J. (2012). How Creativity Powers Science. *Science News for Students*. Retrieved May 3, 2017, from https://www.sciencenewsforstudents.org/article/how-creativity-powers-science

Garret, B. (2017). *Making Time for Creativity is Crucial for Kids*. Retrieved from Huffington Post: http://www.huffingtonpost.com/entry/making-time-for-creativity-is-crucial-for-kids_us_590fba5fe4b046ea176aecb4

Greenwood, M., Cooke, M. B., Ziegenfuss, T., Kalman, D. S., & Antonio, J. (2015). *Nutritional Supplements in Sports and Exercise.* Heidelberg: Springer.

Hancock, L. (2011). *Why are Finland's Schools Successful?* Retrieved from Smithsonian.com: http://www.smithsonianmag.com/innovation/why-are-finlands-schools-successful-49859555/

Harvard University (2007). *Learning Through Play*. Retrieved from Center of Developing Child, Havard University: http://developingchild.harvard.edu/innovation-application/innovation-in-action/learning-through-play/

Longshaw, S. (2009). Creativity in Science Teaching. *School Science Review, 90*(332), 91 - 94. Retrieved May 1, 2017, from file:///D:/data%20on%20C%207-1-15/Downloads/SSR332Mar2009p91.pdf

Moldave, K. (2012). *RNA and Protein Synthesis.* New York: Academic Press Inc.

Nierhaus, K. A., & Wilson, D. (2009). *Protein Synthesis and Ribosome Structure.* John Wiley & Sons.

Ouvinen, L. (2017). *Towards a knowledge-based bioeconomy: Cities and regions call for a review of EU policies*. Retrieved from The EU's Assembly of Regional and Local Representatives: http://cor.europa.eu/en/news/Pages/Towards-a-knowledge-based-bioeconomy.aspx

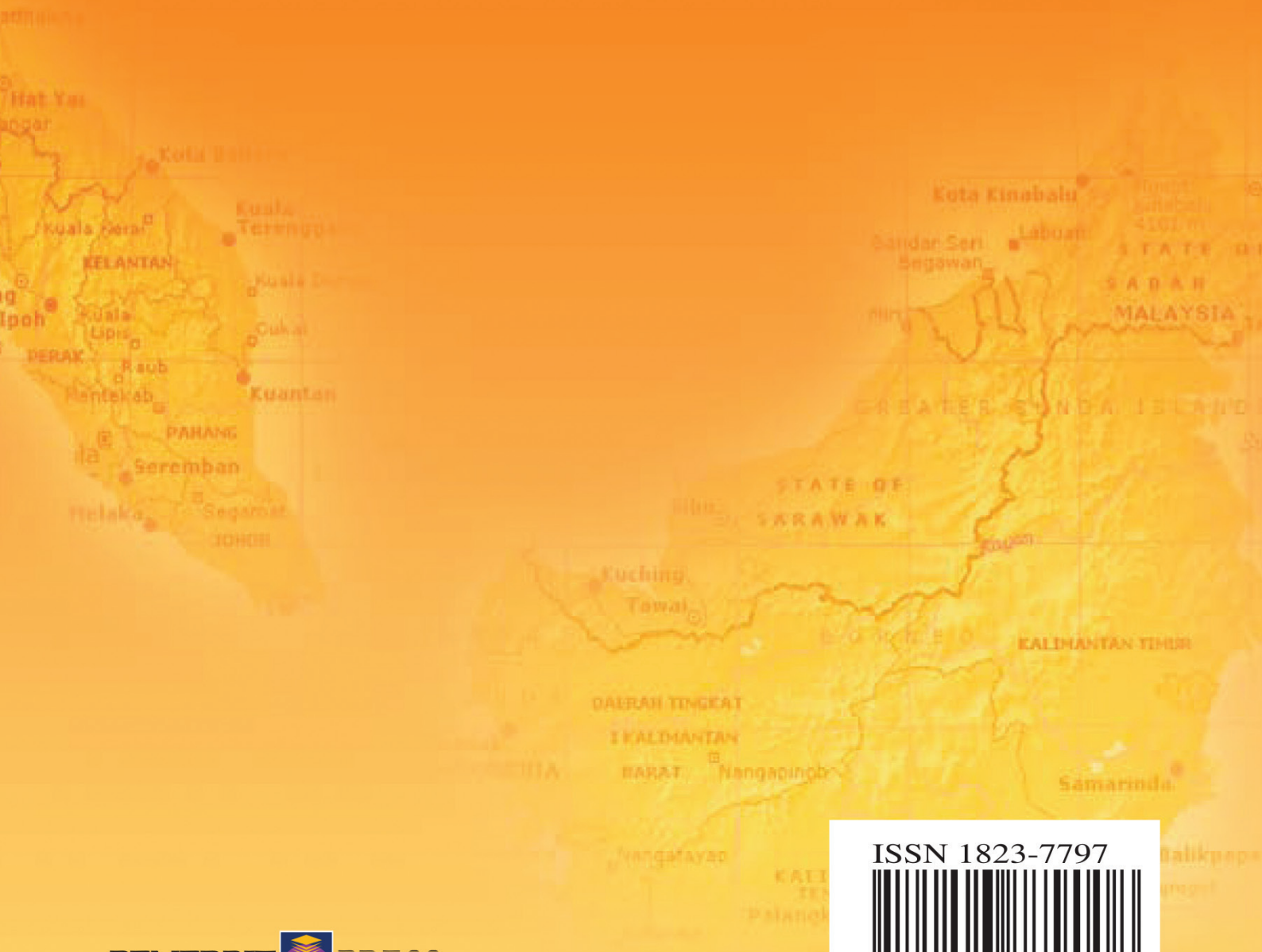
Raven, P. H. (2005). *Biology.* New York: McGraw-Hill, Higher Education.

Rudin, M., Beckmann, N., & Rausch, M. (2006). Evaluation of Drug Candidates: Efficacy Readouts during Lead Optimization. (M. Rudin, Ed.) *Process of in Drug Research: Imaging in Drug Discovery and Early Clinical Trials, 62*.

Spirin, A. S., & Swartz, J. R. (2014). *Cell-free Protein Synthesis: Methods and Protocols.* New York: John Wiley & Sons.

Volpe, S. L. (2016). Muscle Protein Synthesis and Metabolic Health in Older Adults: Comparison of Different Types of Protein. *ACSM's Health & Fitness Journal*, 31 - 32.

ACRULeT
ASIAN CENTRE FOR RESEARCH ON UNIVERSITY LEARNING AND TEACHING



ISSN 1823-7797

PENERBIT PRESS
UNIVERSITI TEKNOLOGI MARA